Medical students' knowledge and attitudes regarding vaccination against measles, influenza and HPV. An international multicenter study

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Abstract: Introduction: Inaccurate information leads to increased scepticism concerning vaccinations among health care workers. Therefore, a proper education of medical students on vaccination is important. Methods: During summer term 2015, we performed a paper-based survey to identify the knowledge and attitudes of medical students on vaccinations against measles, influenza and HPV in seven medical schools in Germany, Austria and Switzerland. Results: Altogether, 3,652 questionnaires were analyzed. Knowledge of country-specific public recommendations increased significantly with the number of semesters of medical studies. Concerning the knowledge about vaccinations against measles, influenza and HPV, one third of the answers were given correctly. Again, a strong correlation between the knowledge and the semester of medical studies could be observed. The attitudes concerning vaccinations in general and especially for HCWs were highly positive. Conclusions: This study provides some important arguments for the development of a comprehensive vaccination education for medical students.

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ORIGINAL ARTICLE

Medical students' knowledge and attitudes regarding vaccination against measles, influenza and HPV. An international multicenter study

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Keywords

Medical students • Health care workers • Vaccination

Summary

Introduction. *Inaccurate information leads to increased scepticism concerning vaccinations among health care workers. Therefore, a proper education of medical students on vaccination is important.*
Methods. *During summer term 2015, we performed a paper-based survey to identify the knowledge and attitudes of medical students on vaccinations against measles, influenza and HPV in seven medical schools in Germany, Austria and Switzerland.*
Results. *Altogether, 3,652 questionnaires were analyzed. Knowledge of country-specific public recommendations increased significantly with the number of semesters of medical studies. Concerning the knowledge about vaccinations against measles, influenza and HPV, one third of the answers were given correctly. Again, a strong correlation between the knowledge and the semester of medical studies could be observed. The attitudes concerning vaccinations in general and especially for HCWs were highly positive.*
Conclusions. *This study provides some important arguments for the development of a comprehensive vaccination education for medical students.*

Introduction

Infectious diseases have been significantly reduced or even eradicated by vaccines and they are one of the most cost-effective prevention measures, saving millions of lives each year.
Despite the well-established benefits of immunization, lacking or omitted vaccinations remain a public concern [1]. Insufficient immunization rates are not only a problem in the public but also among health care workers (HCW) in Europe, although immunization of HCWs is a major issue for infection control in healthcare facilities [2]. Because of their contact with patients or infectious material from patients, many HCWs are at risk of vaccine preventable diseases (VPD) e.g. influenza and measles. Many institutions strongly recommend (not mandatory) vaccination for HCWs to protect them from infectious agents, but also to prevent nosocomial transmission of pathogens and its consequences [3]. Medical students already belong to health care professionals during their medical training and will be one of the main contact persons regarding vaccinations in the future.
Concerning social cognitive variables underlying the decision of HCW for getting vaccinated (or not), data show mostly similar results for vaccination in different European countries. Self-protection, patient and family members protection were reported as most important reasons for getting vaccinated. Reasons for rejecting vaccinations were fear of side effects caused by the vaccine, a low risk-perception, disbelief in the effectiveness of influenza vaccination, organizational barriers, misconceptions, and undefined negative emotions [4]. Previous studies showed that inadequate knowledge of physicians regarding vaccines and patient eligibility for vaccination reduced vaccination rates. In addition, HCWs attitudes towards vaccines directly influenced patient's decisions to accept or reject vaccinations [5-7]. Additionally, reported positive or negative experiences with vaccines prior to and during education at medical school may have an impact on future physicians' recommendations about immunizations of patients [8, 9]. Therefore, it seems crucial that medical students acquire solid knowledge of vaccination, resulting in good skills and attitude to be prepared for competent and evidence-based counseling of patients. However, empirical data on this issue are limited so far. The aim of the current survey was to evaluate on a broad basis the information status and personal attitude

towards vaccination in medical students of three different German-speaking countries.

Materials and methods

This descriptive observational study was conducted at seven medical schools in Germany, Austria and Switzerland between June 2015 and October 2015. In Germany, we included the medical schools of the Ludwig-Maximilians-University (LMU) Munich, the Technical University of Munich (TUM; main study center), the University of Duisburg-Essen, the Saarland University (Homburg/Saar) and the Technische Universität of Dresden (TUD). In Austria we involved students of the medical schools at the University of Innsbruck and the Medical University of Vienna. Switzerland was represented by the Medical School at the University of Zurich. These medical schools were chosen to include a wide range of the German-speaking area of Europe. We aimed to include as many medical students as possible. The survey was handed out to the medical students mainly after annual exams, progress tests or compulsory courses. Participants were provided orally with information concerning the purpose of the survey, anonymity and the voluntariness of participation before handing out the questionnaires. The research ethics board of the medical faculty of the Ludwig-Maximilians-University (LMU) Munich reviewed and approved the study (file number AZ 12-15; confirmation date: 08.01.2015).

As there were big differences concerning the number of evaluated questionnaires of each country, the subsequent results of the three countries were not comparable. To get as complete an impression as possible, also partly filled questionnaires were included in the evaluation.

The survey covered the topics of demographic data (8 items), general vaccination related questions (2 items), and knowledge about vaccinations against measles, influenza and against HPV (5 items each). These diseases /vaccines were chosen, because measles should be eradicated by 2020, influenza vaccination is a major issue in HCW and HPV is a comparable new vaccine. We were asking for different attitudes towards vaccinations in general (3 items), vaccinations against measles (5 items), vaccinations against influenza (2 items) and vaccinations against HPV (3 items). The questions concerning knowledge about vaccinations were answered with "yes/no/I don't know". The attitude regarding vaccinations was rated with "I agree/ I disagree/ I don't know". The participants were advised not to guess. For detailed information the questionnaire can be found as supplemental material.

The statistical analysis was performed by IBM SPSS Statistics 24 (version 2016) and GraphPad Prism 6. Sociodemographic data, students'knowledge and attitude were presented by descriptive statistics (percent [%], means [M] and standard deviations [SD]). To analyze different influences on student's knowledge we performed statistical hypothesis testing (t-tests [p-value < 0.05]), as well as a multiple regression analysis (regression coefficient [r] and commonality [h^2]).

Results

Demographic data

During the survey period, 19,521 medical students were enrolled at the participating universities, of whom 7,617 students (39.0%) could be reached after annual final exams, progress tests or compulsory courses.

Finally, 3,671 questionnaires could be evaluated. 2,015 (54.9%) of the evaluated questionnaires came from German medical schools, 1,160 (31.6%) from Austria and 496 (13.5%) from Switzerland. The participants were mainly 20-25 years old (n = 2.980; 81.2%), female (n = 2,204; 60.0%) thus representing the overall majority of female students in medical schools. Most of the participants were in their 6th semester of medical studies (n = 584; 15.9%) (Tab. I).

Knowledge about vaccinations

Concerning their knowledge, students were asked about their awareness of the country-specific public recommendations for HCW. 2,405 participants (65.5%) stated, they would not know these recommendations. However, we could observe a strong correlation between knowledge and progress of years of study. While only 65 students (16.3%) in their first semester stated to be aware of the country-specific public recommendations concerning vaccinations for HCWs, 73 students (64.0%) in the 11th semester and 43 students (62.0%) in the 12t^{h} semester of their studies confirmed this statement (Fig. 1).

Furthermore, we asked five questions concerning the immunization against measles, as well as five questions concerning the immunization against influenza, respectively HPV (15 items in total; see online supplement).

On average, the participants were able to answer 1.66 of these five questions about measles correctly. Also 1.60 of the five questions concerning influenza and 1.81 of the questions concerning HPV were answered correctly on average. In absolute numbers, 3,439 students were able to give at least one correct answer concerning measles. 3,380 students were able to give at least one correct answer concerning influenza and 3,395 students were able to give one or more correct answers concerning HPV.

We observed a strong correlation between the knowledge and the semester of medical studies. As students in their first semester were able to give 2.6 correct answers on average (n = 360; SD = 2.585), medical students in their 10th semester gave 7.7 correct answers on average (n = 355; SD = 2,869; Fig. 2).

A significant correlation between former training for health care profession, such as medical technical assistant, emergency medical technician, a certified training in outpatient-service or education in nursing care, and the knowledge about vaccinations could not be observed (p = 0.227).

Tab. I. Demographic data of participants showing age, gender, semester and former medical training of students in Munich, Homburg, Dresden, Essen, Vienna, Zurich, Innsbruck.

	Age in years				Sex			Semester of medical studies		Former training for health care profession	
	20-25	26-31	> 31	Total	Female	Male	Total	Mean	Standard deviation	No	Yes
Munich LMU/Essen	808	255	36	1099	688	404	1092	6,96	1,99	838	241
Munich TUM/Homburg	426	78	22	526	339	182	521	7,38	1,42	451	72
Vienna	307	57	3	367	190	178	368	6,88	3,43	251	116
Dresden	254	121	9	384	240	150	390	6,24	3,79	264	123
Zurich	449	37	6	492	312	184	496	5,65	3,35	478	10
Innsbruck	736	39	9	784	435	357	792	3,61	2,59	585	198

Fig. 1. Correlation between the self-reported knowledge about country-specific public recommendations concerning vaccinations for HCWs and semester of medical studies ($p < 0.001$, $h^2 = .061$).

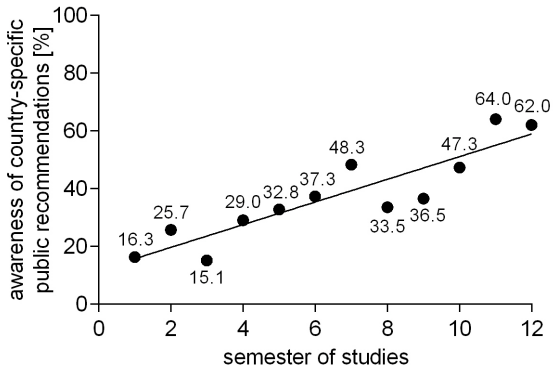
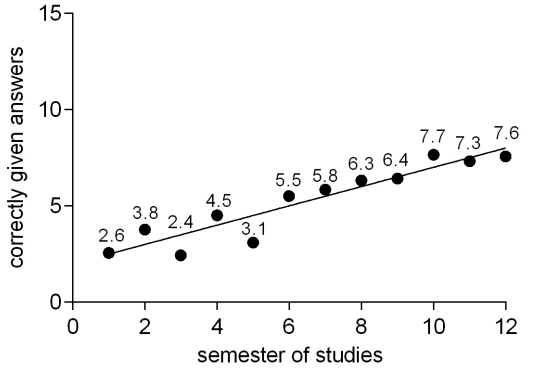


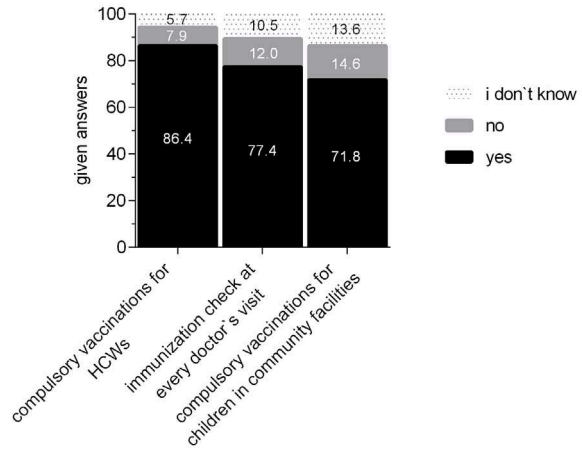
Fig. 2. Correlation of number of semesters and knowledge about vaccinations, mean values of correct given answers are indicated ($r = 0.503$; $p < 0.001$; $n = 3161$).



Attitudes towards vaccinations

Concerning HCWs, most of the participants would support more strict regulations for prevention of infectious diseases. 3.172 students (86.4%) agreed, that compulsory vaccinations should be introduced for HCWs in hospitals, ambulatory settings and midwifery practices. 2,841 participants (77.4%) approved that every doctor`s visit should be used to check the immunization status of a patient, as well as 2,636 students (71.8%) stated that vaccinations should be compulsory for children who are going to visit public community facilities like day care centers or kindergartens (Fig. 3).

Fig. 3. Attitudes towards immunization of HCWs, general public and children in community facilities.



When we asked our participants for possible obstacles to influenza vaccinations for HCW, "ineffective protection" was named in 1,725 cases (47.0%), and 1,376 participants (37.5%) mentioned "fear of side effects". The statements "the vaccination makes me sick" and "I am not at risk" were checked in 870 (23.7%) and 855 (23.3%) of all questionnaires, respectively.

Discussion

Vaccination is an important issue within primary prevention measures, especially for HCWs. Our survey of medical student`s knowledge and attitudes towards vaccination revealed several important findings. First, the knowledge among medical students about vaccinations especially against measles, influenza and HPV is poor in the analyzed German-speaking countries. In addition, the attitude of medical students towards vaccinations of HCWs and the general public was very positive.

Although immunization rates and the acceptance of vaccinations seem to be higher in medical students than in students of other subjects, immunization rates and knowledge about vaccinations are still insufficient among medical students in many European countries.

For example, more than 10% of the medical students at the Technische Universität Dresden did not even know their immunization status [10]. In Frankfurt (Germany), only 46.4% of the medical students knew that there was a general recommendation for HCW to receive the influenza vaccination and only 76.8% of the students stated to have received two measles vaccinations. Overall, two thirds of the students were "very much in favor of vaccinations" or "completely in favor of vaccinations" and estimated the probability for unvaccinated HCWs to acquire an occupationally associated infectious disease to be "quite high" or "very high" [11].
Another cross-sectional survey with 711 students studying a range of subjects in Dresden (Germany) showed a high acceptance regarding vaccination against measles. Actual self-reported vaccination rates were lower; only 65.5% of medical students and 25.3%-39.4% of other student groups reported complete vaccination against measles. Of the students, 12.6%-45% did not know their vaccination status. Consequently, vaccination acceptance did not correlate with vaccination behaviour [12].
These results are not surprising, as teaching of vaccination topics for medical students in Germany is still not part of a compulsory curriculum [13, 14].
Combined with our findings about the lack of knowledge among many students due to a missing vaccination education, these results suggest the probable receptivity of medical students to educational interventions related to immunizations [15]. Efforts to standardize immunization training for medical students as part of their curriculum would most likely benefit from reinforcement by the development of immunization core competencies [14].

Limitations of the study

We did not define a mandatory setting for the cooperating medical schools. Therefore, an unspecific bias is always possible. Some students were invited to participate during a compulsory course, other students at the end of a progress test or final exam. These different settings could have influenced the answers given. In addition, a selection bias is likely favoring those students who were present on the occasions where questionnaires were distributed. We did not match the time points of filling out the questionnaire and acquiring the vaccination-associated learning content with each other. Therefore, differences between the medical schools may also be attributed to curricular heterogeneity. Furthermore, the teaching methods and curricula in those countries might differ, which may in turn influence the knowledge level. Bias associated with self-report questionnaires is quite common and can potentially influence the outcome. Additionally, there might be other variables which might influence students` knowledge and attitudes which could not be taken in to consideration in this study.

Conclusions

To date and to our knowledge, no study comprehensively examines knowledge and attitudes of medical students in different German-speaking countries. Therefore, we performed a baseline survey to identify basic knowledge and attitudes of medical students especially concerning measles, influenza and HPV in seven different medical schools in Germany, Austria and Switzerland.
The results of the survey demonstrate the impact of current medical school curricula towards knowledge about vaccinations among medical students of the compared faculties. The survey also provides valuable information about medical student exposure to preventive medicine practices and their associations towards attitudes concerning vaccination. These findings may result in the creation of an educational tool for better training of medical students.
It is tempting to speculate that medical students positively view vaccinations, and they would probably be receptive to more education and training related to vaccines. Further studies should extend the survey to other medical school populations and explore the development of an educational intervention to address the identified knowledge gaps and boost student confidence about vaccines. We also suggest that medical institutions should consider standardizing a set of core competencies for immunization for all European medical students.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

LS and HR coordinated the data collection and evaluation, they equally contributed to the manuscript. MB and P.O.B evaluated the data. JB, BG, BH, AL, HR, KV, AK and UW collected the data at the respective study center, and supported data evaluation as well as the development of the manuscript itself. LS, HR, P.O.B and JS were responsible for the study design and the development of the questionnaire.

References

[1] Meyer C, Reiter S, Siedler A, Hellenbrand W, Rasch G. Über die Bedeutung von Schutzimpfungen Epidemiologie, Durchimpfungsraten, Programme: Epidemiologie, Durchimpfungsraten, Programme. Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz 2002;45:323-31. https://doi.org/10.1007/s00103-002-0398-z

[2] Maltezou HC, Poland GA. Vaccination policies for health-care workers in Europe. Vaccine 2014;32:4876-80. https://doi.org/10.1016/j.vaccine.2013.10.046

[3] Alfonsi VCM, Rota MC, Declich S. Promotion of immunization for health care workers in Europe; 2012. State of the art report,

overview of health-care workers immunization status in Europe. Available at: http://www.hproimmune.eu/downloads/HProImmune_State_of-the-art-report.pdf (last acess: 29_06_2020)

[4] Lehmann BA, Ruiter RA, Wicker S, van Dam D, Kok G. "I don't see an added value for myself": a qualitative study exploring the social cognitive variables associated with influenza vaccination of Belgian, Dutch and German healthcare personnel. BMC Public Health 2014;14:407. https://doi.org/10.1186/1471-2458-14-407

[5] Smailbegovic MS, Laing GJ, Bedford H. Why do parents decide against immunization? The effect of health beliefs and health professionals. Child Care Health Dev 2003;29:303-11. https://doi.org/10.1046/j.1365-2214.2003.00347.x

[6] Johnson DR, Nichol KL, Lipczynski K. Barriers to adult immunization. Am J Med 2008;121:S28-S35. https://doi.org/10.1016/j.amjmed.2008.05.005

[7] Freed GL, Clark S, Cowan AE, Coleman MS. Primary care physician perspectives on providing adult vaccines. Vaccine 2011;29:1850-4. https://doi.org/https://doi.org/10.1016/j.vaccine.2010.12.097

[8] Pelly LP, Pierrynowski MacDougall DM, Halperin BA, Strang RA, Bowles SK, Baxendale DM, McNeil SA. THE VAXED PROJECT: an assessment of immunization education in canadian health professional programs. BMC Med Educ 2010;10:86. https://doi.org/10.1186/1472-6920-10-86

[9] Betsch C, Wicker S. E-health use, vaccination knowledge and perception of own risk: drivers of vaccination uptake in medical students. Vaccine 2012;30:1143-8. https://doi.org/10.1016/j.vaccine.2011.12.021

[10] Kümmerle M, Voigt K, Schübel J, Bergmann A, Riemenschneider H. Kenntnis des impfstatus, impfraten und impfakzeptanz knowledge of vaccination status, vaccination rates and vaccination acceptance. Prävention und Gesundheitsförderung 2017;12:261-6. https://doi.org/10.1007/s11553-017-0604-3

[11] Petersen S, Roggendorf H, Wicker S. Vaccine preventable diseases: knowledge, attitudes and vaccination status of medical students. Gesundheitswesen 2017;79:394-8. https://doi.org/10.1055/s-0035-1547274

[12] Riemenschneider H, Schübel J, Bergmann A, Kugler J, Voigt K. Current vaccination status regarding measles among university students in Dresden, Germany. Am J Infect Control 2015;43:1363-5. https://doi.org/10.1016/j.ajic.2015.07.018

[13] Weinberger S, Jocham A, Krane S, Schelling J. Erstmalige Datenerhebung: reisemedizinische Lehre an deutschen Universitäten–Einheitliche Lernziele, Strukturen und Lehrangebote fehlen noch. Flugmedizin Tropenmedizin Reisemedizin-FTR 2014;21:290-4. https://doi.org/10.1055/s-0034-1399750

[14] Vogel B, Reuter S, Taverna M, Fischer M, Schelling J. Vaccination: developing and implementing a competency-based-curriculum at the Medical Faculty of LMU Munich. GMS J Med Educ 2016;33:doc5. https://doi.org/10.3205/zma001004

[15] Petersen S, Roggendorf H, Wicker S. Impfpräventable Erkrankungen: wissen, einstellung und impfstatus von medizinstudierenden. Gesundheitswesen 2017;79:394-8. https://doi.org/1055/s-0035-1547274

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